Evaluation, Monitoring and Expedient Repair of Concrete in Navigation Structures

Inland Waterways Navigation Conference
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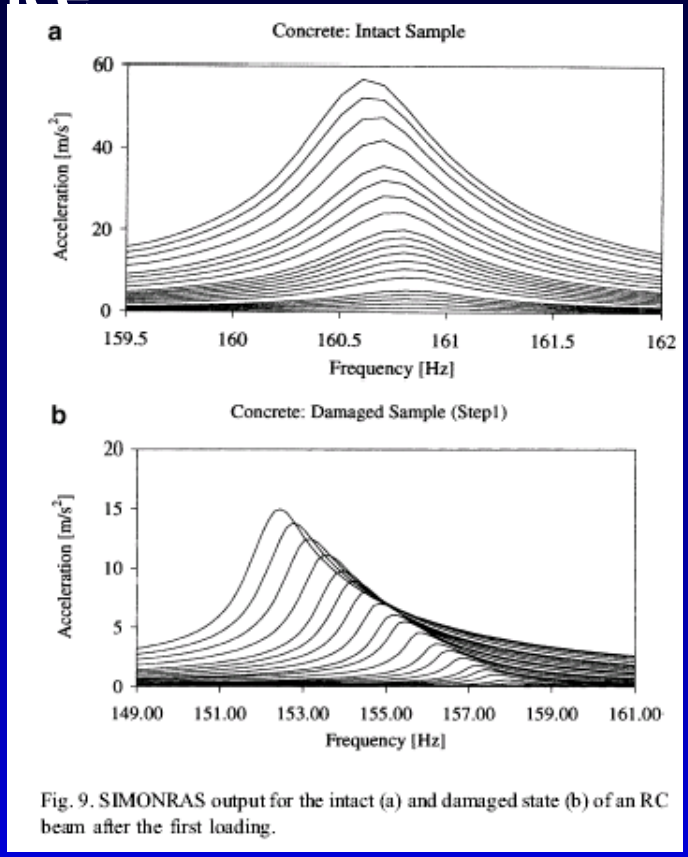

Fig. 9. SIMONRAS output for the intact (a) and damaged state (b) of an RC beam after the first loading.

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Concrete's Role in Navigation Structures

- Concrete supports & protects operational hardware
  - Problems are chronic to the structure
  - Ultimately significant to operations

Problem

- Long-term deterioration of concrete
- Damage caused by
  - ASR
  - Cold weather
  - Particularly in pre-1940 structures
  - General service wear

Alkali-Silica Reaction (ASR)

- Na/K in cement
- Reactive aggregate
- Water driven
- Expansive reaction

Damaging ASR

Cold Weather Damage

- Water saturated concrete
- Cycles of freezing and thawing

>60 Years F&T Cycles

Freezing and Thawing Damage 1930's Era Structure

Newer Structures (Post ~1950)

In theory should not suffer ASR and F&T Damag

Newer Structures
F&T, ASR!

F&T

ASR

1970's Structures

General Wear from Service Loads

Impact Damage

What Do We Need to Do?

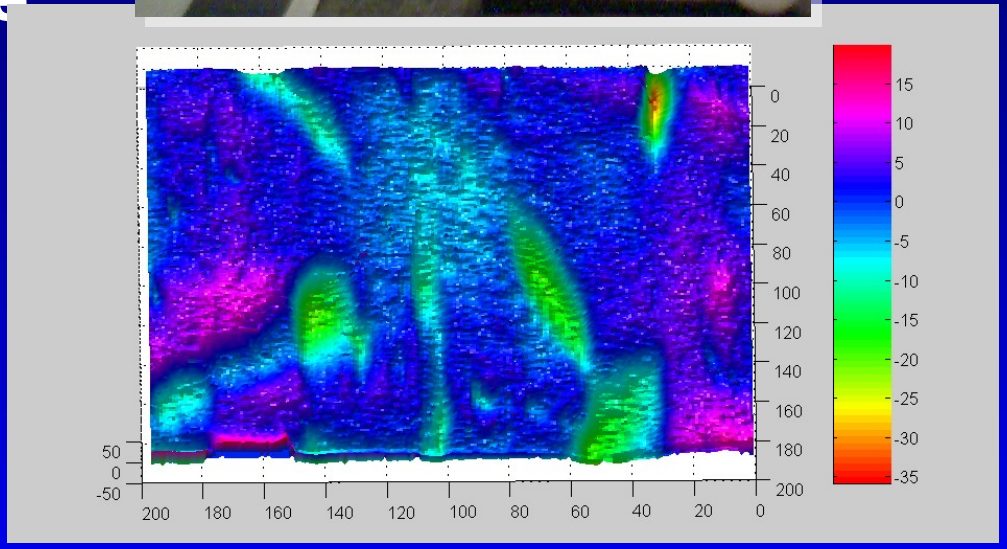
- Real-time monitoring
- Predict rates and ultimate damage
- Repair for interim use

Traditional Monitoring

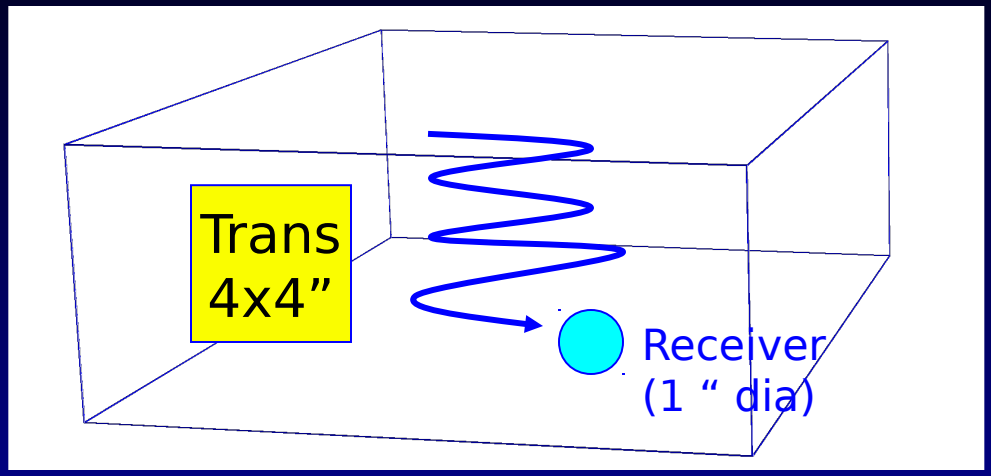
- Visual
- Sounding
- Coring

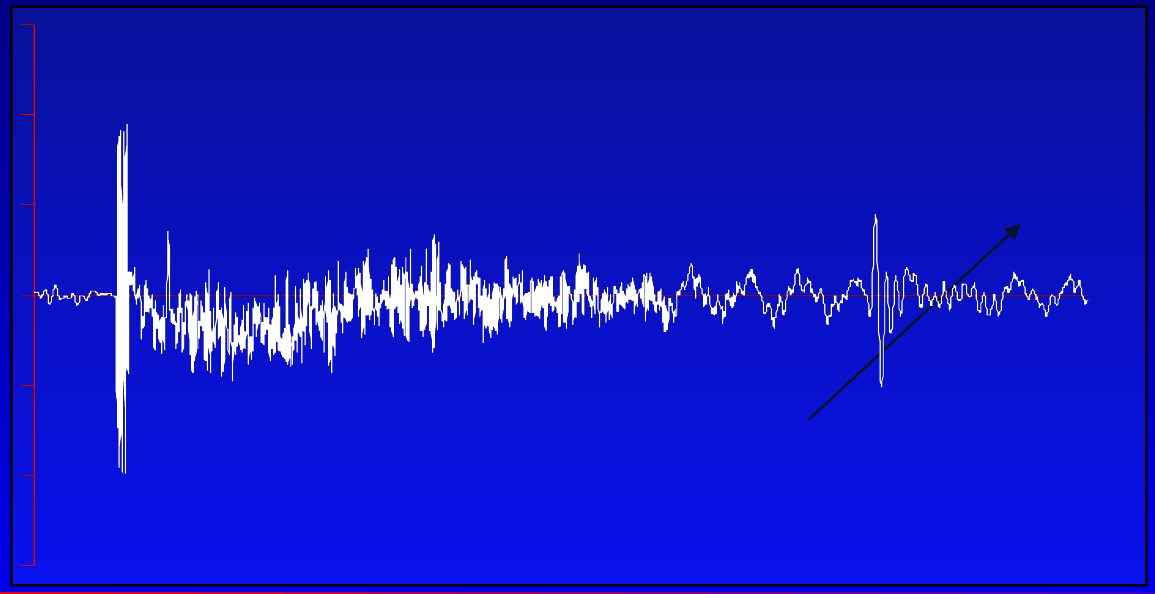
Low-Cost 3D Laser Imaging

- Quantifying impact damage
- Deterioration
- Cracking
- <$300 hardware cost

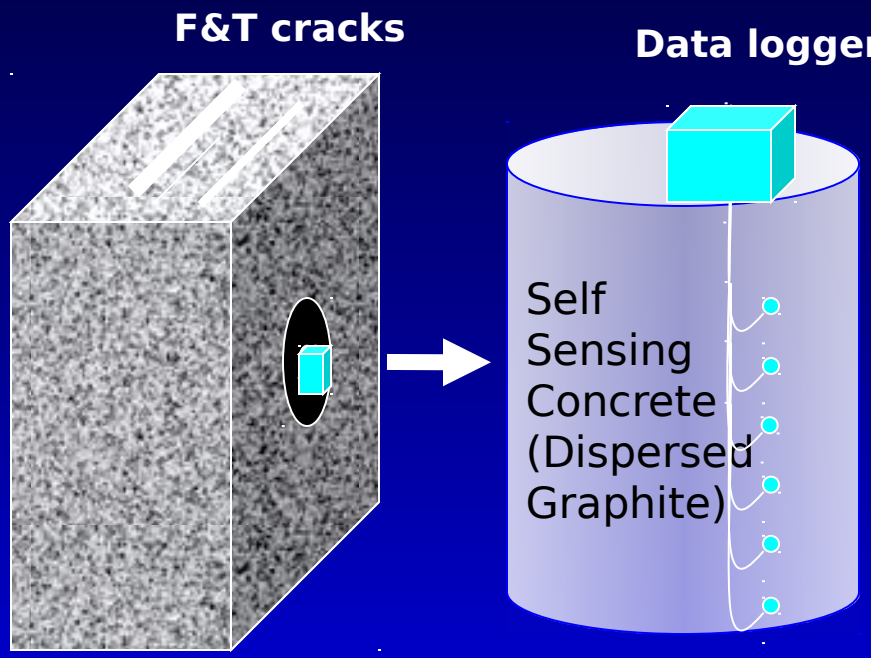


Ultrasonic Pulse Echo





Core Hole Sensor

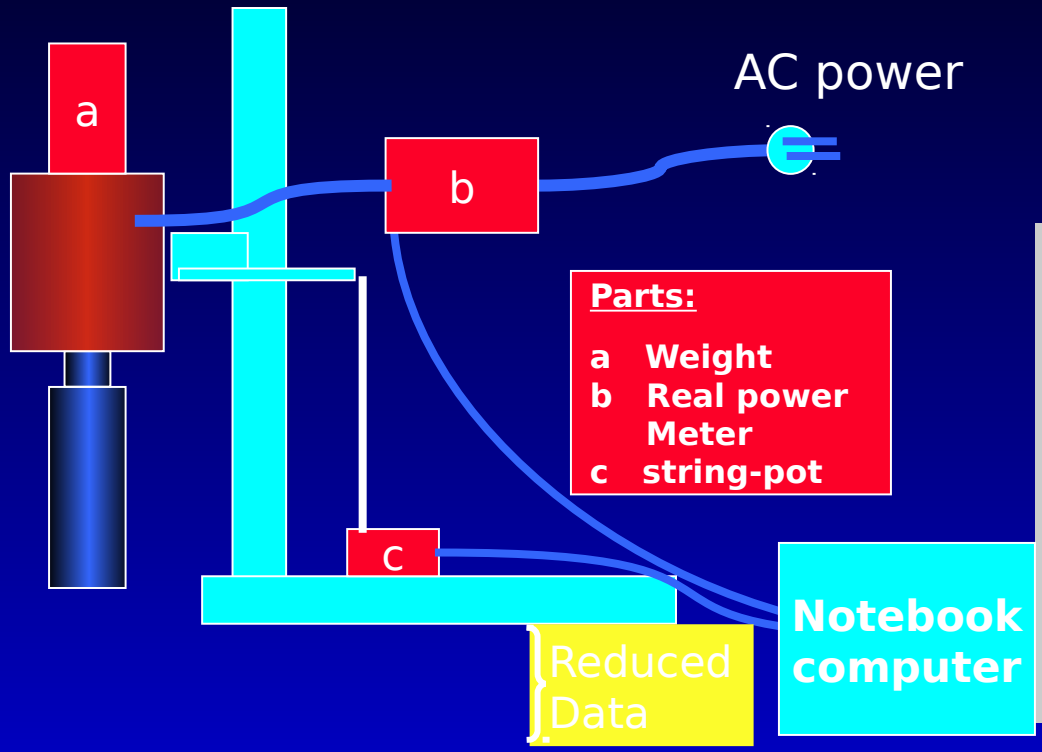


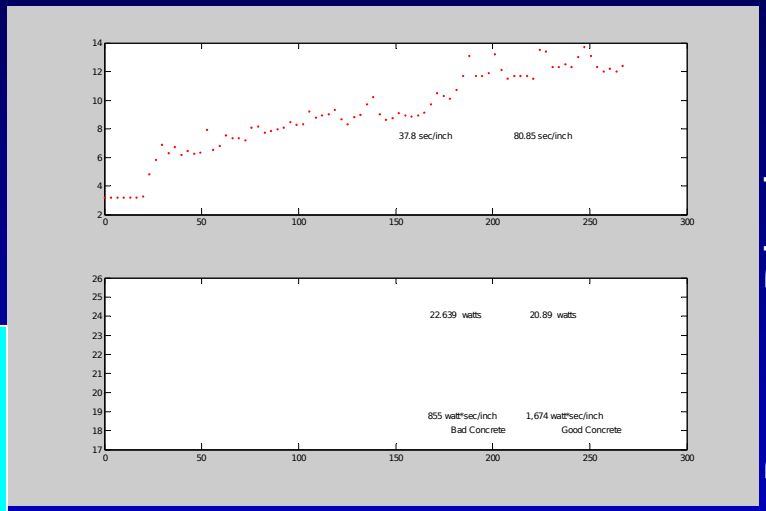
-Self Sensing Concrete

-Carbon Fiber based

-Strain Measurements

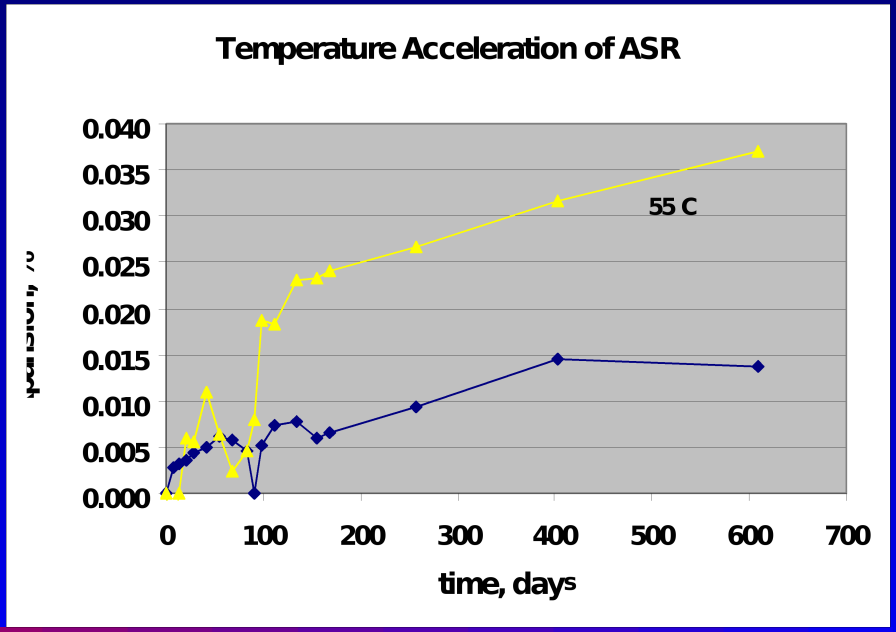
Smart Core System





Laboratory Evaluation

- Current Status of Damage
- Rate of future expected damage
- Ultimate damage



Products & Users

- **ASR**
  - Evaluation of lithium treatments
  - Test methods for estimating rate and ultimate effects
- **Cycles of Freezing and Thawing**
  - Evaluation of topical strengtheners
  - Concepts for Interim repairs that slow down damage
- **Monitoring**
  - Development of improved monitoring tools
- **Users - CoE O&M**